THE DEPARTMENT OF DEFENSE

THE RESTRUCTURED BALANCED TECHNOLOGY INITIATIVE PROGRAM

FOR THE

COMMITTEES ON ARMED SERVICES

COMMITTEES ON APPROPRIATIONS

UNITED STATES CONGRESS

JANUARY 1990

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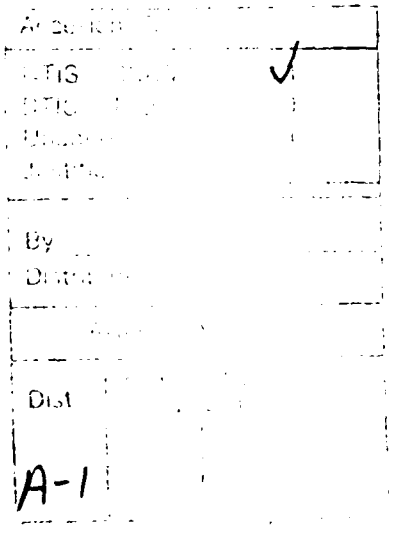
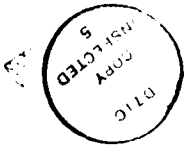
TABLES





I. INTRODUCTION

This report is submitted in response to language in the Senate Defense Appropriations Bill for Fiscal Year 1990.[1] That language "directs that none of the funds provided for BTI be obligated or expended until 30 days after the Defense Department reports to Congress as to how it is improving the management of the program to capitalize fully on its potential." Further, the "Committee expects the required report will demonstrate specifically how OSD is restructuring the program, including: which projects have been terminated; which old and new projects will be funded in fiscal years 1989, 1990, and 1991; the 5-year costs for each project; the specific reasons why each merits BTI funding; and how each contributes directly to achieving the overall objectives of the BTI program."

The Balanced Technology Initiative was created by the 99th Congress with funding for FY1987 to "expand research on innovative concepts and methods of enhancing conventional defense capabilities."[2] The Congressional language required the research and development efforts to emphasize eight areas[3] and further required that "the Director of Defense Research and Engineering apportion the funds among the research, development, test, and evaluation accounts of the Army, the Navy, the Air Force, and the Defense Agencies on a merit basis...."

Forty-eight projects were started or adopted by the BTI program in FY1987, and 15 new projects were started in FY1989 using reprogrammed FY1988 funds. These

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1 Defense Appropriations Bill, Report of the Senate Appropriations Committee, Report 101-132.

2 Defense Authorization Act, P.L. 99-661, Sec. 222.

3 "(A) Armor/antiarmor initiatives.

"(B) Defenses against armed helicopters.

"(C) Hypervelocity missiles for ground combat use.

"(D) Defense against antiship missiles, including those with 'stealth' characteristics.

"(E) 'Smart' mines for both land and ocean warfare.

"(F) Lightweight, air transportable vehicles with antiarmor capabilities for rapid transport to remote areas.

"(G) Improved conventional antisubmarine warfare munitions.

"(H) 'Smart' standoff munitions and submunitions for aircraft delivery outside of lethal air defense ranges."

projects, their funding and goals were described in two DoD reports submitted to Congress in May 1987 and April 1989. Considering completions, consolidations, terminations and transfers, the total number of active projects in the summer of 1989 was 49. These were grouped into five categories: smart weapons technology; reconnaissance, surveillance and target acquisition/battle management-command, control and communications (RSTA/BMC3) technology; armor/antiarmor technology; high power microwave technology; and special technology opportunities. Goals and schedules were defined for all of the projects.

At a hearing held on June 14, 1989, and in the subsequent report,[4] the Senate Armed Services Committee (SASC) stated the goal of the BTI program and reiterated strong support for the program but expressed several serious concerns. The goal is "to provide the Department of Defense with capabilities to better address obvious gaps in our conventional defense through the application of 'leapfrog' technologies; technologies that potentially can render obsolete entire elements of enemy structure on a wholesale basis."

The Committee expressed concern that the Department of Defense has not placed sufficient emphasis on the program, has not displayed sufficient high-level management leadership, and has not adhered to the original goals and objectives of the program. The Committee directed a review of the overall program relative to its original goal and provided specific instructions for conducting the review. The Committee called for a "vigorous culling process to eliminate those programs which do not exhibit adequate progress or promise so that programs with greater potential can be supported" and for close involvement, independent assessment, and regular reviews by higher management.

The DoD began immediately to make the changes and take the actions indicated by the SASC. Following the June 14 hearing, the Director of Defense Research and Engineering (DDR&E) appointed a special assistant full time to resolve the BTI issues. With the special assistant, the DDR&E conducted a detailed review of the legislation and report language and a detailed review of the program then current. He revised the program objectives to be fully consistent with the new understanding of the wishes of the Congress. He made the management changes described in this report and recruited a Director, BTI. The Under Secretary of Defense for Acquisition expressed the Department's strong support

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[4] National Defense Authorization Act for Fiscal Years 1990 and 1991, Report 101-81, Committee on Armed Services, United States Senate.

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19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

The Balanced Technology Initiative (BTI) Program has recently redirected its goals and reorganized the administrative structure of the program office. The new focus of the BTI program is the transition and application to system concepts of those technologies that can prove leapfrog improvements in our ability to fight conventional war. Using a top down approach, goals can be stated in terms of desired operational capabilities drawn from the identification of advanced technologies appropriate for application to those system concepts which will exploit adversaries vulnerabilities. The BTI program is managed through a newly created office, reporting directly to the Director, Defense Research and Engineering (DDR&E), and through him to the Under Secretary of Defense for Acquisition. The Director of the BTI program is now authorized to develop and control the BTI program by direct contact with the Services through the Service Acquisition Executive (SAE) program. This report discusses both the goals and organization of the BTI program as well as the specific technologies identified as being of particular value for BTI application.

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for the BTI program and for conducting the program in full compliance with Congressional direction.

II. THE CHANGED CHARACTER OF THE BTI PROGRAM

A. THE NEW FOCUS

The DoD initially judged that the focus of the BTI program was to be on accelerating the development and demonstration of advanced technologies that held great promise for enabling important new military capabilities. "Technology" was interpreted in the sense of a physical discipline, not in the sense of an application of a group of physical disciplines.

Recent Congressional direction has led to a reinterpretation of program focus. Our new understanding is that the program should be striving to transition and apply technologies to system concepts that can provide leapfrog improvements in our ability to fight conventional war. The new focus, then, is on developing and demonstrating system concepts having such leapfrog potential. Most such concepts require the application of advanced technologies that have never before been fielded.

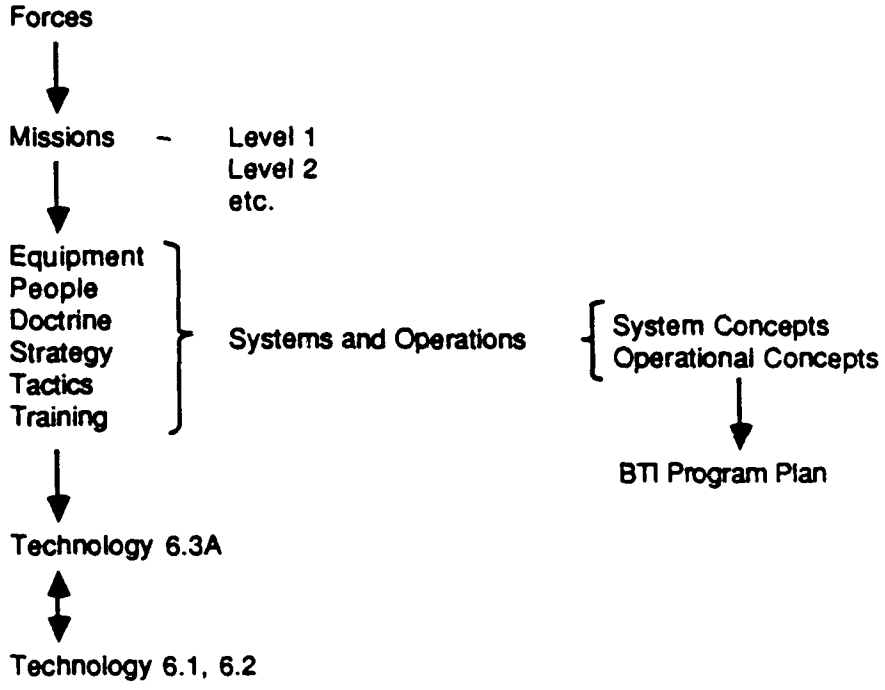
The DoD goal for BTI is the goal stated by Congress, *to provide the Department of Defense with capabilities to better address obvious gaps in our conventional defense through the application of leapfrog technologies, technologies that potentially can render obsolete entire elements of enemy structure on a wholesale basis.*

B. USE OF TOP-DOWN PLANNING FOR PROGRAM DEVELOPMENT

Consistent with DoD's initial focus, the first BTI office requested project nominations from the Services and DARPA; established committees that evaluated and ranked the nominated projects, using as guidance areas listed by Congress; and then selected as many of the highly ranked projects as could be accommodated within available BTI funding. This bottom-up planning approach resulted in a collection of important projects, many of which have achieved new levels of technical performance over the 3 years of the program; however, the overall goals of the program and the accomplishments of individual projects were not considered adequate by key Congressional committees.

The new approach to planning the BTI program is from the top down. As directed by Congress, the process involves the use of the latest intelligence information to identify

characteristics of enemy forces that we can exploit. System concepts that can be realized by application of our advanced technologies and that exploit enemy vulnerabilities are defined, and projects to develop and demonstrate these system concepts are planned. With this top-down approach, goals can be stated in terms of operational capabilities, and improvements of leapfrog proportions can be realized if the goals are achieved. The planning process is explained more fully in Section III-C-5, p. 13.



C. THE RELATION OF BTI TO DARPA AND THE SERVICES

The Defense Advanced Research Projects Agency (DARPA) was chartered to conduct advanced research projects that develop or apply the latest technologies. DARPA has long been identified with high-risk, high-payoff projects and with basic and applied research that can lead to major new capabilities. BTI also strives to achieve major new capabilities through advanced technologies, so there is a degree of similarity between DARPA and BTI.

The central theme of BTI is to demonstrate system concepts that meet the most critical Service needs. Concentrating on the most critically needed capabilities and less on technology leads to relatively shorter projects using relatively more mature technology than is typical of DARPA projects.

The BTI program does little to develop technology but does much to apply technology. Relative to BTI, the DARPA program includes a much greater effort in basic and applied research to develop technology. The early research endeavors involve uncertainty both in schedule and in result, so they are not appropriate for near-term application to system concepts.

There have been suggestions that additional demonstrations can be a way to smoothly transition DARPA-developed technology to military systems. To some extent BTI can play this role.

In summary, then, BTI is directly concerned with recognized (typically near-term) Service needs and strives to accelerate the application of advanced technology to satisfy these needs. BTI does not support basic research and is less involved in applied research than is DARPA. On the scale of RDT&E activities from basic research (6.1) to full scale development (6.4) BTI is mostly 6.3a. BTI does not duplicate the program management structure of DARPA but manages BTI projects through the existing Service and DARPA organizations.

The Services are engaged in every facet of acquisition from basic research to production and operation. Furthermore, the Services define their requirements and plan for future needs by mission areas and by major system type. The Services also prioritize their needs to obtain the greatest benefit from the available budget. How, then, with Service acquisition budgets two orders of magnitude greater than the BTI budget, can BTI contribute significantly? What distinguishes BTI from the Service development program?

BTI has several advantages relative to Service programs.

- **Flexibility and Responsiveness.** Congress has wisely provided that the content of the BTI program be determined by BTI management. This permits quick startup of a project to meet a critical need when the need becomes known or when technology that enables a capability is developed. Also, projects that fail to meet objectives can be redirected or canceled, and funds can be shifted to build on success.
- **Environment for Multi-Service Projects.** BTI projects are selected and planned in a multi-Service environment and under the scrutiny of OSD oversight groups. This encourages projects that serve multiple needs and projects that integrate the efforts of Service developers. The BTI environment reduces the risk of unplanned overlap of development efforts.

- **Acceptance of Risk.** Use of emerging technology involves risk that is less acceptable in the formal atmosphere of Service development agencies and procedures than in the less formal atmosphere of the BTI program.
- **Balance Between Platforms and Weapons.** The Services necessarily emphasize acquisition of the best platforms (e.g., tanks, ships, aircraft) because excellence in platforms is basic to Service capabilities. However, this emphasis on platforms contributes to a relative inferiority in weapons. The BTI program can respond to this imbalance by emphasizing advanced weapons and targeting systems.

The BTI program is not duplicative of Service programs and does not compete with Service programs. Instead, BTI works with the Services and with Competitive Strategies and other elements of the OSD staff to identify critical needs that are not being adequately met. Then BTI works with the Services to meet those needs.

III. IMPROVED BTI MANAGEMENT

A. ELEVATION OF BTI OFFICE IN DDR&E ORGANIZATION

From the beginning of the BTI program in FY1987 the Director, Defense Research and Engineering, managed the BTI program through an office established within the organization of the Deputy Director for Research and Advanced Technology. The choice of this location reflected the then-current view of the nature of the program.

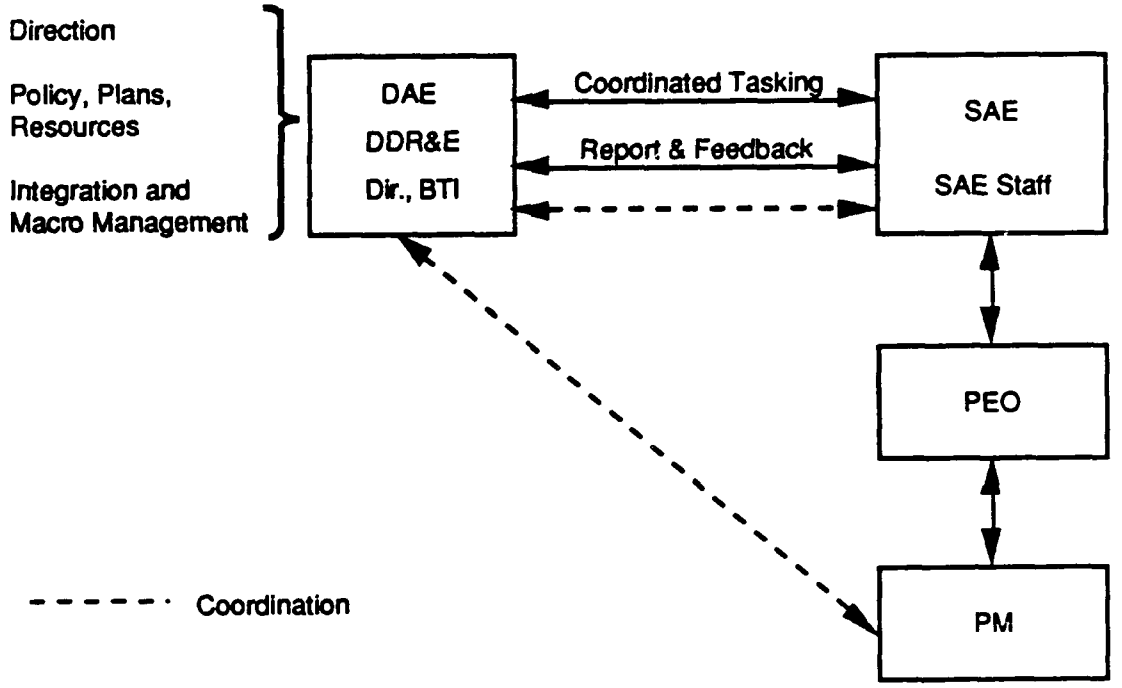
Both in a hearing and in a Committee report, Congress has stated that the BTI program has not received enough high-level management attention in DoD. In response to this criticism and with the full support of the Under Secretary of Defense for Acquisition, the DDR&E has created a new office for the management of the BTI program. This office is headed by the Director, Balanced Technology Initiative, who reports directly to the DDR&E and through the DDR&E to the Under Secretary of Defense for Acquisition, the Defense Acquisition Executive (DAE). This change will improve communications and operational authority and will result in greater attention to the program at the DDR&E and higher levels.

B. CHANGE FROM OVERSIGHT TO MANAGEMENT

Probably the most fundamental change made in the management of the BTI program is that the Director, BTI, is now authorized to develop and control the BTI program by direct contact with the Services through the Service Acquisition Executive (SAE) organization. The Director develops the overall BTI program and establishes program goals, schedules and budget; he controls the projects within the program by controlling acquisition strategies, objectives, schedules and budgets. He conducts reviews of the projects and the overall program, and he reshapes the program when necessary by modifying program goals and by initiating and terminating projects.

The structure of management relationships between the Director, BTI, and each of the Services and DARPA is illustrated in the following diagram. This structure is derived from existing agreements between the SDIO and the Services with changes that reflect the current acquisition structure. The Director, BTI, exercises his macromanagement

responsibilities through the SAE organizations. The SAEs, in turn, exercise their management responsibilities through the Program Executive Officers and Program Managers. The BTI Program Directors coordinate with Service Program Executive Officers (PEOs) and PMs but do not have authority to direct these Service officials. This structure is fully consistent with the streamlined management recommended by numerous studies of Defense acquisition and currently being implemented under the title "Defense Management Review."



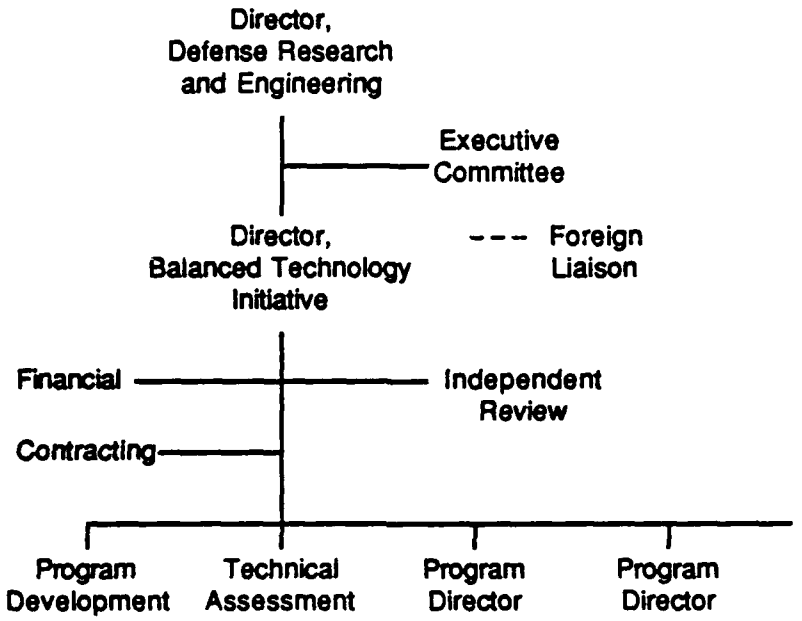
The Director, BTI, is both *responsible* to the Defense Acquisition Executive (DAE) and *responsive to the direction* of the DAE in carrying out these management functions. Other portions of the OSD staff having oversight responsibility for projects within the BTI program continue to provide their normal oversight function, particularly with respect to projects that are likely to develop into major acquisition programs.

The Director, BTI, is the DoD point of contact with Congress for BTI. He keeps Congressional staff informed of the program status, problems and accomplishments; prepares and provides testimony as needed; and prepares the annual and special reports required by Congress.

C. ORGANIZATION AND FUNCTIONS

1. Organizational Structure

As specified in the founding legislation, the BTI program is managed by the DDR&E. He exercises this management function with the help and advice of an executive committee (EXCOM) through the Director, BTI, as shown in the organization chart below.



2. Executive Committee

The Executive Committee, or "EXCOM," is the highest level advisory group for BTI matters. The DDR&E is the EXCOM Chairman; the Vice Chairman of the Joint Chiefs of Staff (VCJCS) is the Co-Chairman. Other members are the Principal Deputy Under Secretary of Defense for Strategy and Resources, the Deputy Under Secretary of Defense for Industrial and International Programs, the Assistant Secretary of Defense for Special Operations and Low Intensity Conflict, the Assistant Secretary of Defense for Program Analysis and Evaluation, the Assistant Secretary of Defense for Command, Control, Communications and Intelligence, and the three Service Acquisition Executives.

Membership on the EXCOM was designed to provide advice from experts on the needs of our regular forces and the Special Operations Force, on the needs and concerns of friendly nations, on the analysis of our forces, and on major technologies and systems.

The EXCOM meets when requested by the DDR&E or the VCJCS, especially when the annual plan and budget request are being prepared and when the annual report to Congress is being written.

3. Director, BTI

The Director, BTI, serves the DDR&E and Defense Acquisition Executive to plan and carry out the BTI program. His functions were listed earlier under Section III-B, "Change from Oversight to Management." They include all the usual management functions of planning, staffing, resourcing, scheduling, budgeting and controlling. As with most OSD activities, planning is accomplished in conjunction with the Services, staffing and resourcing include obtaining the support of Service organizations and DARPA, and budgeting includes a range of activities necessary to balance the request for BTI with the remainder of the Defense budget and finally involves shaping the program to conform to the budget appropriated. The single feature of the new BTI management that distinguishes it most markedly from the previous BTI management is that the Director, BTI, is now authorized to exercise high level management of the BTI program by direct contact with the SAE/PEO/PM chain of command.

4. Independent Review

The Director, BTI, benefits from the judgments, advice and recommendations of a group of senior retired military and former executives of DoD and industry. These advisors have already contributed to the program. They studied the latest intelligence of current and projected Soviet/Warsaw Pact warfighting capabilities, then they considered Competitive Strategies and other recent analyses, and with that background they identified areas that have leapfrog potential. They recommended major thrusts for BTI and examined the status of the current projects for their potential to greatly improve our warfighting capabilities. Their recommendations were key inputs to the vigorous culling needed to restructure the program and meet budget constraints.

The Director, BTI, will continue to utilize independent reviews for examining opportunities and potential projects. In particular, there will be close coordination between BTI and the Competitive Strategies initiative. We are in a period of rapid change requiring frequent assessment of the correlation of military capabilities between the United States and its potential adversaries. Competitive Strategies offers an effective methodology for doing this. An ongoing relationship between BTI and Competitive Strategies will help to ensure

that BTI efforts identify key technologies and weapon systems that take advantage of U.S. strengths, exploit opponents' weaknesses and maximize the deterrent effect of U.S. defenses.

5. Program Development

The top-down planning described earlier is supported by a systematic investigation of the threat, the operational capabilities needed to exploit vulnerabilities in threat systems, and the system concepts and technologies that can be brought to bear to realize the needed operational capabilities. This investigation, conducted under the direction of a deputy to the Director, BTI, will be more fully described in Section III-D, pp. 14-16.

6. Technical Assessment

Technical assessment must be performed both as a part of the program development activities and as a part of the project review and control process. In program development, technical assessment is used to assure that system concepts are technically sound and to establish the technical performance capabilities and realistic goals. In project review and control, technical assessment provides an independent view of accomplishments and potential. Simulation is a vital part of technical assessment for many development projects, both to guide the optimization of the design and to troubleshoot.

7. Program and Project Management

The BTI program is composed of several major segments called "thrust areas." Each thrust area relates to an operational function or mission or to a technology area directed toward an operational capability. BTI program goals are defined at the level of the BTI thrust areas because at this level goals can be expressed in terms of mission operational capabilities. Typically, several individual projects are necessary to meet the goals in a thrust area. A Program Director is responsible to the Director, BTI, for the management of one or more thrust areas and the corresponding projects.

Service Program Managers[5] for the individual projects are responsible through the Service PEO/SAE chain for meeting the objectives of their projects. The three BTI

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5 The title "Project Manager" would be more precise, but to be consistent with common practice the title "Program Manager" is used.

Program Directors maintain close coordination with the Program Managers and PEOs of their assigned projects to ensure that the goals of their thrust areas are met.

In the BTI program, as in any acquisition program, the Program Managers (PMs) are key to program success. The BTI management philosophy, implemented through agreements between the Director, BTI, and the SAEs, is that the PMs have both the responsibility and the authority to manage their projects within the constraints of strategies, goals, schedules and budgets established by coordinated directives from the Director, BTI, to the SAE. The Director, BTI, and SAEs are responsible for establishing *realistic* goals, schedules and budgets. Service PEOs provide assistance to the PMs in obtaining support for their projects. Program Managers assist the Director, BTI, in presenting program accomplishments and status to Congress.

8. Financial Management and Contracting

Financial management and administrative support for the BTI office are provided by the Defense Technology Analysis Office (DTAO), an existing OSD Management Support Activity. DTAO reviews implementation plans, participates in technical reviews, maintains financial records on the BTI program and on the individual projects, prepares financial summaries, and assists in the preparation of budget requests.

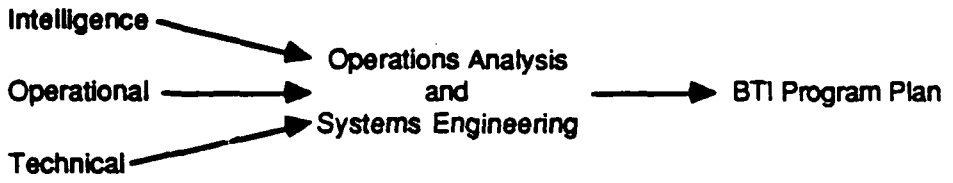
To date, BTI contract activity has been performed by the Services or by DARPA. This practice is expected to continue. However, if the need arises to contract directly, the Director, BTI, will be supported by contracting officers from the Washington Headquarters Services organization .

D. PROGRAM DEVELOPMENT

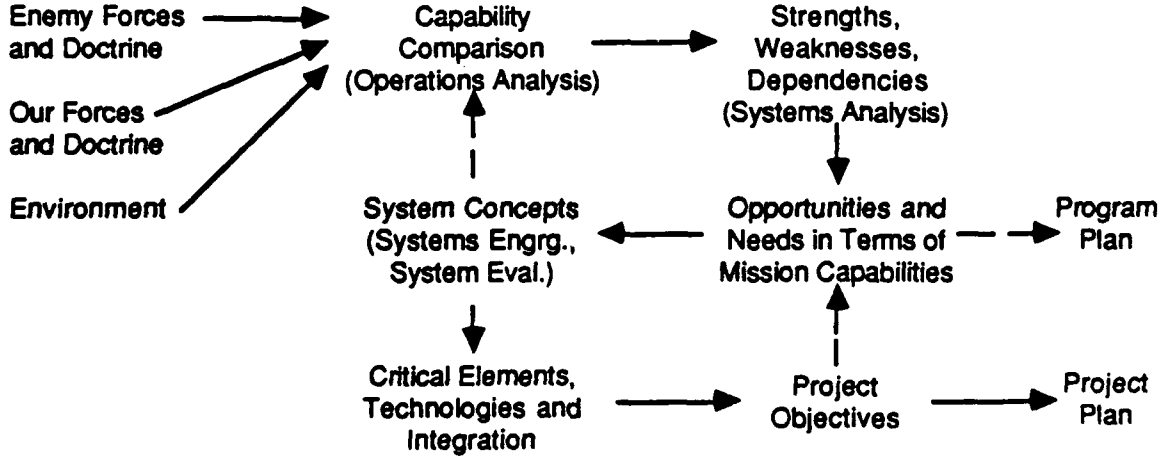
Restructuring of the BTI program has led to a review of the program and a refocusing of effort into a few program thrust areas. This restructuring was accomplished quickly through a logical top-down planning process. The same general process will be used in the future, but by taking more time the process can be more adequately supported by analysis and by master planning of system and mission areas. The more complete process to be used in the future will be discussed next. The process as shortened for restructuring the FY1990 program is explained later in Section IV, "The New BTI Program."

Program development is accomplished with the participation of four different communities: intelligence, operations, operational analysis, and technical. Intelligence

participation is coordinated by a Defense Intelligence Agency representative. Participation by operators is arranged by the Service points of contact. Technical and operational analysis is provided by the Institute for Defense Analyses (IDA) and by DTAO. The BTI Deputy for Program Development manages the process by planning, preparing task orders, arranging support, reviewing analysis plans and progress, and redirecting as necessary.



The process of program development is illustrated more fully in the diagram below. Information relating to forces, system capabilities and operational employment is obtained from the intelligence community and operators. This information is the basis for capability comparisons that utilize operations analysis at theater and lower levels. All levels can disclose relative strengths, weaknesses and critical dependencies of the forces, systems and operational employments. These analyses permit the identification of possible opportunities and critical needs that can be expressed in terms of mission operational capabilities.



The next step is to try to formulate system concepts and operational concepts that can provide the needed capabilities. Scientists are major contributors to the formulation of these concepts.

At this point, capability comparisons can be performed again to determine the contribution that potentially can be realized by introducing the new system. Technical and operational analysis is then used to assess technical risk and to identify critical elements and technologies, including any particularly difficult integration of systems or operations. If risk is not excessive, the mission capabilities previously identified as needed are adopted as program goals.

From the system definition and the identified critical elements, project objectives and subobjectives are defined. After assessment of the time and cost needed to lower risks and to develop and demonstrate the system concept, project plans are prepared. Project plans state project goals, activities, milestones and costs. In some cases several projects are required to realize the system concept.

E. TECHNICAL ASSESSMENT

As just described, technical assessment plays a key role in developing the BTI program. It plays an equally important role in supporting the management of the BTI projects. Both IDA and DTAO will perform technical assessment activities for the Director, BTI. Subcontract support will be utilized when necessary.

During program development the technical community must assist in formulating system concepts, must identify technologies that can enable the system concepts, must judge the limitations and maturity of these technologies, and must compute the expected technical performance of the resulting systems. This requires a mature, competent technical organization that will maintain expert knowledge of the latest developments in a wide range of enabling technologies. IDA maintains such a position by providing technical support to DARPA, SDIO and other parts of OSD. On the other hand, DTAO supports the Science and Technology Investment Strategy, the Critical Technologies Master Plan and the Defense Acquisition Board Committees. Thus, the BTI program can benefit from these other activities while providing funds for only those additional investigations and design activities that are uniquely or principally required for BTI.

Throughout the lifetime of a project there is a need for technical analysis and simulation for design optimization, troubleshooting, analysis of tests, establishing technical standards and measuring performance against those standards. Program Managers are responsible for these activities for their individual projects. However, the Program Directors and the Director, BTI, need an independent resource to provide a check of the project performance and to supplement the project in areas beyond normal project

responsibilities. For example, the simulation of a complete system concept might well involve simulation of component systems from several projects or component systems that are being developed outside the BTI program.

Countermeasures and counter-countermeasures must be considered in any system design and are hence the responsibilities of the PMs. However, the BTI office will use IDA and DTAO to provide an independent assessment of the susceptibility of the overall system concept and its components to countermeasures.

Similarly, cost and technical performance are responsibilities of the PMs, but the BTI office must provide a knowledgeable review of these factors.

IV. THE NEW BTI PROGRAM

A. PROCESS USED TO DEVELOP FY1990 PROGRAM

Direction to restructure the BTI program was included in Congressional actions taken late in FY1989 pertaining to the new Defense budget. There was not sufficient time to follow the program development process outlined in Section III because any previously started BTI projects that remain part of the program will be interrupted if funding is delayed far into FY1990. Accordingly, several of the steps were combined and, instead of using detailed analysis to support each step, the process relied on the operational, technical and managerial competence and experience of a group of senior advisors.

The senior advisors received the latest intelligence briefings on enemy systems and operations for conventional warfare. Then they were briefed on Competitive Strategies, Net Assessment, Follow-On Force Attack (FOFA) and several other relevant investigations of conventional warfare. With this background they individually suggested the areas and projects that they considered most suitable for BTI, i.e., those likely to provide leapfrog capabilities, having funding requirements not totally out of line with the expected funds available. The advisors discussed the criteria for BTI projects and critiqued the suggestions of their peers. A representative set of criteria, as stated by one of the advisors, is listed in Annex 1.

Next, the senior advisors conducted an independent review of the projects previously initiated by the BTI program and not yet completed or terminated. The Services, DARPA and the OSD Offices of Munitions and Research and Advanced Technology briefed the BTI projects that they are executing. The advisors individually judged the projects relative to the criteria each advisor had established. These criteria always included the potential for leapfrog improvement of our conventional warfighting capability, Service interest, and the likelihood that a Service will build upon the work of BTI to achieve an operational capability. Knowing that the FY1990 program could afford only about a third of the existing projects, the advisors individually listed their few top

choices and pointed out any projects that they judged to be of low priority or inappropriate for the BTI program.

The Director, BTI, with assistance from the Services, then developed a program for recommending to the DDR&E. Several projects appeared to overlap substantially with other BTI or Service projects. In some cases the BTI projects were modified or dropped from the program.[6] In other cases of apparent overlap, the BTI and Service projects are being jointly replanned to eliminate duplication and achieve maximum efficiency.[7] The new BTI program, presented in the following section, has goals in six thrust areas. These thrust areas are:

1. Advanced Armament
2. Target Acquisition
3. Battle Management/Command, Control, Communications and Intelligence (BM/C^3I)
4. Smart Weapons
5. Systems Needed by the Special Operations Force
6. High Power Microwaves.

More than half of the previous projects were deleted from the program and will be terminated unless they are funded from other than BTI sources. Three new projects were added, and three existing projects were expanded. Many of the projects deleted would contribute important capabilities in the selected thrust areas; they were removed because of the BTI budget constraint but would compete well for funding under many other circumstances.

The Services, DARPA and several parts of OSD were given an opportunity to review the program, and their comments were considered in arriving at the final program.

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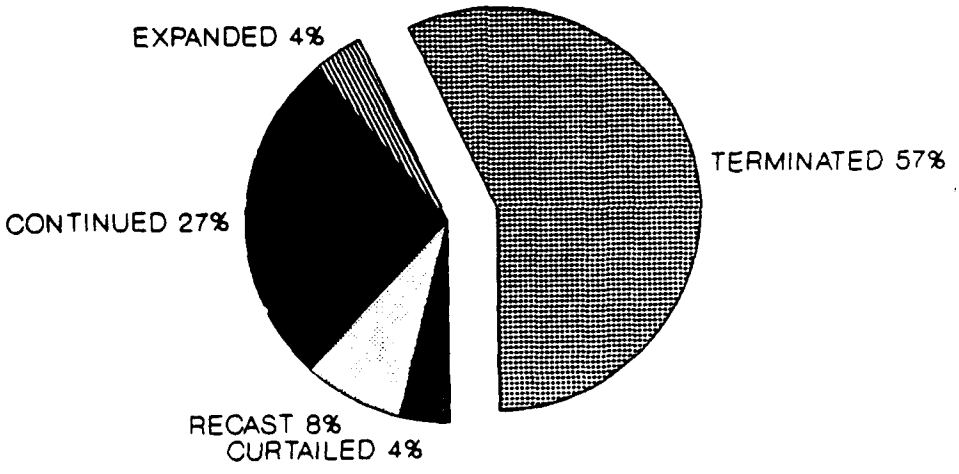
6 For example, the Command Adjusted Trajectory project and the Multi-Sensor Auto Processor project partially overlap other projects. They were dropped from the BTI program although they undoubtedly would contribute additional capabilities if they could be continued.

7 For example, the Low Cost Submunition project, the ET Gun project, the Multisensor-Aided Targeting project, and the IR Countermeasures project all have led to BTI/multi-Service planning.

B. SUMMARY OF CHANGES

Many of the projects that were in the BTI FY1989 program could not be continued in FY1990. The continuation of all FY1989 projects would require nearly $500 million while the funds available are only about $245 million.[8] Additionally, it is considered necessary to initiate several new projects that are unquestionably leapfrog in character and to support a technology specifically directed by the Appropriations Act. As a consequence, the FY1990 program includes only 27% of the FY1989 programs with no significant change. Another 16% were modified in some manner, and 57% were left unfunded by BTI. The disposition of FY1989 projects is summarized in the following chart.

What Happened to the FY1989 Projects?



One recommendation stemming from the June 14 hearing and the subsequent review was to move to fewer projects in order to undertake more significant projects. The current plan starts this process with FY1990 and continues it throughout the FY1990-94 period. The projected number of projects and average level of funding are shown in the following bar charts.

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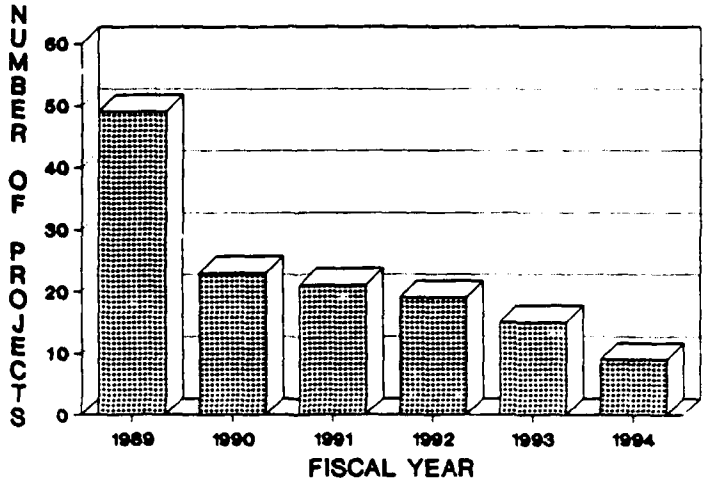
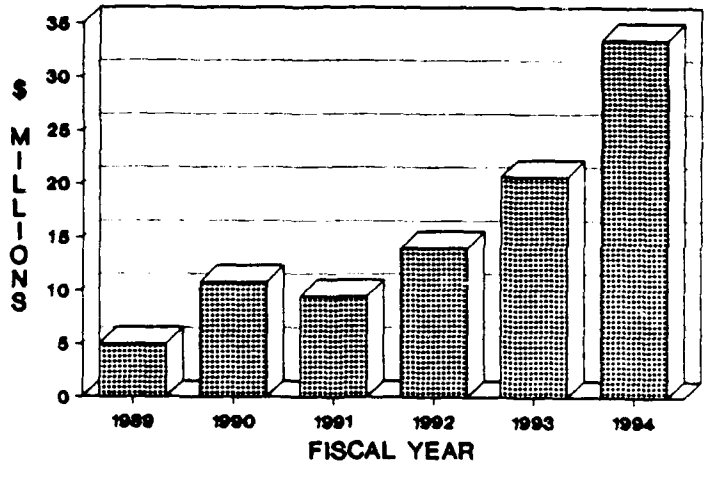
8 Composed of funds appropriated for FY1990 and prior year funds.

Total Number of Projects Is Going Down

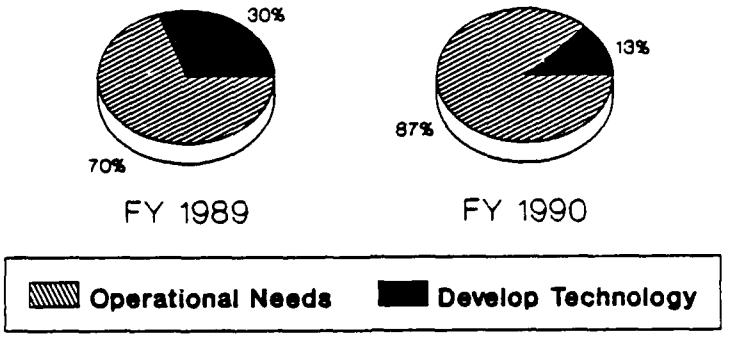


Average Funding Per Project Is Going Up



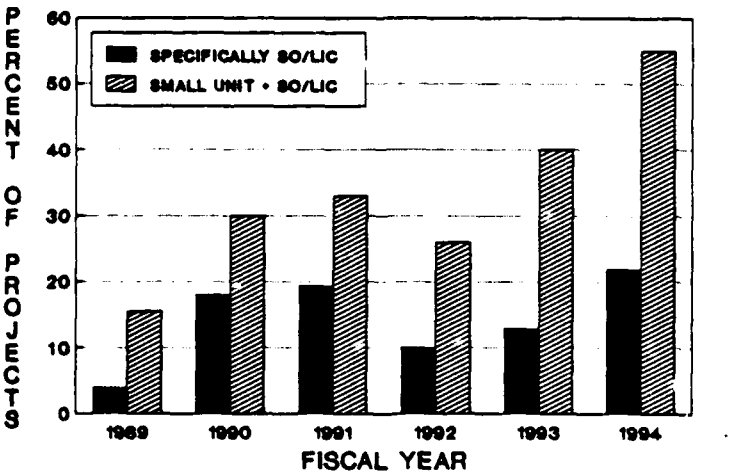
The previous program appeared to be oriented to the technology base. This perception was probably engendered by the large number of projects and the corresponding modest level of funding, and the perception might have been heightened by the inclusion of the word "technology" in project names. While the classification of projects into those principally extending the technology base and those applying the technologies is necessarily a bit arbitrary, about 30% of the FY1989 program was devoted to extending the technology base. In the FY1990 program this activity is reduced to about 13%.

Program Now More Focused on Meeting Operational Needs



Over the last several years there has been a growing realization that the United States must be prepared for wars of lesser magnitude than the NATO-Warsaw Pact conflict of Central Europe. This position is reflected in the formation of the Special Operations Command, and it is punctuated by the recent events in Panama. Nearly all of the projects in the FY1990 BTI program demonstrate capabilities that can be important in special operations, low-intensity conflict and small-unit operations. Again, the classification of projects according to applicability to these less-than-full-mobilization scenarios is somewhat arbitrary, but one such classification, shown here, indicates a movement toward increased support for these scenarios. A second, equally arbitrary classification of the 5-year BTI program is presented in Annex 2. It is important to note that many projects (both in the BTI program and elsewhere) that were initiated to meet needs derived largely from the Central Europe threat are applicable and important to our capabilities in regional conflicts and in SO/LIC.

SO/LIC and Small Unit Operational Needs Are Gaining Emphasis



C. THRUST AREAS AND OBJECTIVES

1. Advanced Armament

- **Goal: Develop a gun and ammunition system that will defeat all projected enemy armor at ranges up to 4 km.**
- **Goal: Develop a gun system that can defeat all supersonic, maneuvering, sea-skimming missiles attacking our surface ships.**

The advanced armament thrust area will demonstrate guns and munitions having immediate application to solve current Service problems. The electrothermal gun (ET Gun) converts an insensitive fluid, by means of an electrically generated plasma, into a highly effective, low-impact loading propellant. This new capability permits lower cost guided rounds and reduced danger to the gun user and vehicle. The large-caliber version to be tested in FY1991 is a high-risk alternative for the main gun for the Army Block III Tank. The smaller caliber, high-rate-of-fire gun to be demonstrated in FY1992 will fit the Navy Phalanx Close-In Weapon System mount and, when coupled with the dual-band radar targeting system mentioned below, will provide an antijam, anticlutter, low-cross-section antiship missile killer.

A guided hypervelocity round (X-Rod) for tank main guns will provide the lethality and the accuracy for first-round destruction of tanks, other armored fighting vehicles, and helicopters at ranges up to 4 km. This round will be demonstrated in FY1992, in time to meet the Block III final round selection.

Several Short-Range Antitank Weapons (SRAWs) will be demonstrated in a shootoff for the Marines. From this shootoff in FY1992 the Marine Corps will select the best design to proceed into full scale development.

To meet the current and emerging threat of multihulled submarines, BTI is developing a followthrough warhead for lightweight torpedoes. This warhead will be lethal against all foreseeable threats and can be launched from several classes of platforms. It will be demonstrated in FY1992.

Enemy attack helicopters and standoff jamming helicopters can play a critical role in the close battle. An Antihelicopter Mine that can be commanded remotely and that can destroy helicopters in flight will be developed by FY1993. It will have application to both defensive and offensive situations. The Army will incorporate the command feature into the Wide Area Mine program.

2. Target Acquisition

- **Goal: Develop an integrated system that will give our manned weapon systems a distinct advantage in finding and destroying enemy vehicles before the enemy can destroy ours.**

A multisensor suite, processors and displays that can greatly increase the situation awareness and can provide for automatic target recognition for ground fighting vehicles will be demonstrated in FY1991-92. By greatly reducing the time required to find targets and deliver fire, this system can give our fighting vehicles a quantum jump in capability. This integrated system developed by BTI will form the basis of the target acquisition/fire control system to be used in the Army's future fighting vehicles and combat aircraft.

Early in FY1991 a dual-band radar fire control system for use in the Navy Close-In Weapon System will be demonstrated. The radar will acquire incoming sea-skimming missiles. It will track multiple outgoing projectiles and the incoming target and will command-guide projectiles to impact the target. Use of both K_u and W bands will provide consistent target acquisition and tracking in the severe multipath and clutter environment posed by supersonic sea-skimming missiles.

A miniature image processor capable of processing tactical IR imagery at normal frame rates will be demonstrated in FY1992. This modular processor can be adapted to numerous smart weapon/smart vehicle concepts, reducing development times and lowering production costs.

- **Goal: Show how advanced technologies for vehicles, sensors, processors and displays can be combined to give our small-unit commanders superior information on the size, location and movements of the nearby enemy force.**

The commanders of brigades, battalions and small task forces have intelligence and targeting needs that cannot be satisfied by current systems. A new project will evaluate concepts for a Battalion Targeting System in FY1991 and, with the assistance of the Army and Marine Corps, will select a concept for development and demonstration.

3. BM/C^3I

- **Goal: Apply advanced internetting of ground vehicles with advanced sensors so that a squad or co...pany can act in a highly coordinated fashion in daylight or darkness, even when fully buttoned up.**

Combat simulations have shown that a force of fighting vehicles operating as a unit, with each element fully aware of the location of the other elements and with each using the combined information from all the sensors on all the vehicles, can be far more effective than a force that must maneuver and fight by using paper maps and voice communications. In FY1992 a multinational BTI/Army/NATO Cooperative R&D program, Combat Vehicle Command and Control, will demonstrate how sensors, navigation systems and communications can be integrated to provide these improvements.

- **Goal: Demonstrate advanced image and data processing systems that greatly facilitate and speed the application of information from the National Technical Means to the battlefield commanders.**

Theater intelligence resources and National Technical Means provide a great volume of messages and sensor data containing information vital to battlefield commanders. However, the volume of data is such that manual systems cannot cope, and as a result much of this information currently goes unused. In FY1990 BTI will demonstrate a situation assessment system that processes intelligence data and provides information readily usable by both intelligence and fighting units. Another system that processes images and messages from National Technical Means and provides indications of enemy unit movements, identifies the units and predicts their future locations is being developed and will be used by troops in an exercise in Europe in mid FY1991. This equipment will remain in Europe to provide an interim operational capability. Demonstration of a complementary system to develop targets for Deep Operations from imagery sources will be conducted during FY1990. If continued, a targeting system will be deployed to Europe.

4. Smart Weapons

- **Goal: Develop a system that will protect our fixed-wing aircraft and helicopters from infrared-guided missiles.**

The latest infrared (IR) seekers are so capable that the current generation of countermeasures (e.g., flares, modulated IR sources) is inadequate. The BTI program has already demonstrated that approaching missiles can be detected and distinguished from the background. By FY1992 a system based on upgrading existing components will demonstrate that large aircraft--transports and bombers--can be protected by detecting and neutralizing approaching missiles. By FY1993 a system suitable for tactical combat aircraft will be developed and demonstrated.

- **Goal: Improve the survivability and effectiveness of our air, land and sea forces by providing munitions with standoff and great precision.**

Smart submunitions can bring revolutionary change to conventional warfare. The current BTI low-cost submunition project (Damocles) is being expanded to evaluate other technologies and system concepts. One or more concepts that can yield smart submunitions costing less than $15,000 will be tested in FY1992.

The effectiveness and survivability of our tactical aircraft can be greatly enhanced by employing weapons that are highly accurate even when launched from beyond the line of sight to the target. Current weapons of this type (GBU-15, AGM-130, DL Walleye) rely on radiofrequency (RF) data links that are expensive and jammable. By FY1991 a fiber-optic data link will be developed for this application, permitting lower cost, jamproof weapons.

A millimeter-wave seeker capable of lockon after launch and less susceptible to environmental factors than the current IR Maverick seeker will be demonstrated in FY1991. The increased standoff range and indirect fire capability will decrease aircraft attrition.

In FY1991 an autonomous infrared seeker that can lock onto a known, fixed ground target and guide to it with great precision will be demonstrated. This autonomous guided weapon will not require a data link and will provide surgical precision even at long standoff distances. The demonstration on a glide bomb will show its applicability to Advanced Interdiction Weapon System (AIWS) and longer range weapons. It will be applicable to special operations/low-intensity combat (SO/LIC) in addition to providing a strategic dimension to conventional warfare.

5. Special Operations/Low-Intensity Conflict

- **Goal: Greatly improve our capabilities for nighttime operations by developing low-cost night vision devices for individuals and vehicles and by improving aircraft low-altitude evasive flight capabilities.**

Night operations are particularly important to our Special Operations Force (SOF). Uncooled focal plane arrays that provide night vision at lower cost and without the logistics burden of external cooling devices are being developed by the BTI program. These advanced night vision devices will be demonstrated in weapon sights, driving sights and security sensors in FY1992 and FY1993.

Several technologies (low-probability-of-intercept radar, terrain following, terrain sensing navigation, stored three-dimensional earth reference, among others) are being integrated to produce a more survivable C-130 transport aircraft for SOF operations. Testing will begin before the end of FY1990. This BTI project applies technology developed for attack aircraft in another BTI project.

6. High Power Microwaves

- **Goal: Determine whether ultrawide-bandwidth technology and light-activated high power microwave technology can provide important new capabilities in radar and communications.**

There are claims that ultrawide-bandwidth technology can give us a new, entirely different approach to low-probability-of-intercept communications and radar detection. This technology potentially can yield extremely fine range resolution, possibly enabling detection of stealthy and camouflaged targets. The BTI program will develop an ultrawide-bandwidth communication source, attempting to achieve high data rates and low probability of intercept. A precise, portable and flexible measurement capability for characterizing RF linear and nonlinear signatures of objects will be developed by FY1993. A coherent light-activated photoconductive array source for radar detection will be developed by FY1994.[9]

D. DISCUSSION OF FY1990 NEW AND EXPANDED PROJECTS

The FY1990 program includes expansion of three existing projects and initiation of three new projects. Two of the projects are classified and cannot be described here; the other four will be briefly discussed next. Detailed planning for the new and expanded projects is under way.

1. Electrothermal Gun

The BTI Electrothermal (ET) Gun project is developing and demonstrating a 120 mm ET gun and ammunition that can be applied to a future Block III Tank. The ET Gun can provide higher muzzle velocity at lower peak chamber pressures than conventional guns and thus has the advantages associated with both higher speed (greater penetration,

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[9] Prior to restructuring, the BTI program had two other projects in high power microwaves. However, this earlier BTI program would have required nearly $500 million in FY1990 to execute. The two high power microwave projects were not selected for continuation at the appropriated funding level. Cancellation of these projects is not a decision to substitute the new high power microwave projects for the old. Such substitution is prohibited by the FY1990 Defense Appropriations Act.

shorter time of flight) and softer launch (reduced hardening requirement for the projectile). The project advances the design of unguided ET projectiles, propellants, power sources and switching systems.

The Navy also has a need for an improved gun for a future Close-In Weapon System (CIWS). ET Gun technology provides several advantages over conventional guns and ammunition--greater safety, lower launch loads, and possibly decreased volume and weight of ammunition. The expanded ET Gun project includes development of a medium caliber (about 60 mm) gun with a relatively high firing rate (120 rounds per minute). The gun system will be developed and demonstrated with unguided rounds; if selected for the CIWS, the Navy will develop the guided rounds necessary for effective defense against supersonic sea-skimming missiles.

2. Low-Cost Submunition

The BTI program has included development and demonstration of a submunition that has considerably more capability than today's only low-cost submunitions [Sense and Destroy Armor (SADARM) and Skeet] while maintaining much lower cost than today's more capable submunitions such as the Terminally Guided Weapon and the Infrared Terminally Guided Submunition (TGW, IRTGSM). This submunition, called Damocles, can be demonstrated in time to make it a candidate to meet the Block II Army Tactical Missile System (ATACMS) requirement.

The development of Damocles is being continued in the BTI program, but because a low-cost submunition is recognized as a critical component of both surface-launched and air-launched weapons, the BTI project is being expanded to include additional technologies. The expanded program will develop and demonstrate submunition concepts for a much broader range of applications by the three Services. Modularity will be investigated as a means to reduce the number of separate developments and the overall cost.

3. Infrared Countermeasure System

The BTI program is continuing a tri-Service IR countermeasure program to develop a system having the size, power and responsiveness to protect tactical combat aircraft--fighters, attack aircraft and helicopters. However, there is an urgent need to protect transport aircraft and helicopters that are used in Special Operations; and by upgrading components of existing countermeasure systems and adding intelligent sensing and control

components this need can be met. The system to meet this immediate need has been added to the IR Countermeasure System project. The system will have an immediate application.

4. Battalion Targeting System

Battalion and brigade commanders need to know what enemy forces are close by and what these forces are doing. This short-range reconnaissance and surveillance is sometimes called "over the next hill" to distinguish it from the longer range needs of higher level commanders.

The need for an over-the-next-hill system is widely recognized, and there are current efforts to meet the need by providing to lower level commanders some of the information obtained from systems operated by corps and higher levels. There also is an effort to develop an unmanned aerial vehicle (the "Close" UAV) that lower level commanders could employ.

The BTI project will explore several alternative concepts that can provide responsive or continuous information with sufficient accuracy to meet weapon targeting requirements while also providing reliable information on enemy force movements. This investigation will make full use of previous efforts but will assess the concepts in light of current advanced technologies (e.g., fiber optics, multistatic radars, terrain correlation). Both expendable and reusable concepts will be evaluated. Concepts will be evaluated relative to current developmental systems, and if a concept provides the potential for a leapfrog improvement, the best such concept will be developed and demonstrated.

E. PROJECTS BY THRUST AREA

Tables 1a through 1e list the individual projects in the restructured BTI program, state the goals of the projects and briefly explain why each project is important to our conventional warfighting capability.

F. PROJECTS THAT HAVE BEEN TERMINATED, COMBINED OR CURTAILED

Tables 2a and 2b give the actual FY1989 obligations and the previously planned FY1990 and FY1991 obligations of projects that have been completed or terminated under the BTI program. Unless Service funding is reprogrammed for the incomplete projects, they will be terminated. Table 2c lists the several projects that have been scoped down or combined with other projects.

G. FY1990 PROGRAM FUNDING PLAN

Table 3 gives the FY1990 Funding Plan for the reorganized program. The FY1991 Funding Plan will be provided after the President's FY1991 Budget Request is submitted to Congress.

While not given in this report, the 5-Year Funding Plan for one project, the Ultrawide-Bandwidth Technology and Light-Activated High Power Microwave, shows no funds in FY1991. This unusual funding profile occurs because the BTI office had not expected to pursue this technology. The technology and potential applications will be investigated by bringing together some of this country's most qualified scientists and RF experts. These scientists will assess the maturity and potential of the technology and will assist the Director, BTI, in formulating the program. Contracts will be let in the last half of FY1990 and will continue work into FY1991. Funds are shown in FY1992 and FY1993 to complete demonstrations of practical applications if earlier work justifies this.

The 5-Year Funding Plan shows totals for FY1992 and later years that exceed the BTI funding in the 5-Year Defense Plan. Delaying the new starts after FY1990 by 1 year would avoid the discrepancy but would delay vitally needed capabilities. The Director, BTI, will seek support within DoD to maintain the planned new start schedule.

Table 1a. Advanced Armament Projects

ELECTROTHERMAL (ET) GUN	
Goals: • Develop both large- (120 mm) and medium-caliber (60 mm) ET gun technology by FY1993. • Develop capability for launching antiarmor projectiles from large-caliber guns at greater than 2.0 km/sec by FY1991. • Develop rapid-fire, 120 rounds per minute, medium-caliber ET gun for antimissile ship defense by FY1993.	Why Project Merits BTI Funding: • Renders enemy tank force vulnerable to our tank guns. • Higher velocity projectiles with potential for retrofit to existing M1 tanks, and transition to Block III Tank. • Provides enhanced range and velocity on the Close-In Weapon System (CIWS) to intercept low-flying antiship missiles. • Improvement in safety of propellants.
ENHANCED KINETIC ENERGY MUNITION (X-ROD)	
Goals: • Develop and demonstrate firing of full-up guided kinetic energy projectiles capable of defeating future tanks at long range.	Why Project Merits BTI Funding: • Dramatically increases the operational range, lethality and accuracy of the Block III Tank gun.
SHORT-RANGE ANTITANK WEAPON (SRAW)	
Goals: • Demonstrate a man-portable, lethal antitank weapon system. • Demonstrate the ability to defeat modern tanks having heavy armor and/or reactive armored vehicles. • Weapon system effective from 17 to 500 m, exhibiting high P_h and high P_k.	Why Project Merits BTI Funding: • Gives Marine infantrymen means to destroy modern tanks. • Provides a lightweight alternative to present antitank weapons deployed by light forces capable of defeating heavy armor. • Demonstrates new penetration concepts applicable to multi-service and SO/LIC applications.

(continued)

Table 1a. Advanced Armament Projects (continued)

FOLLOWTHROUGH TORPEDO WARHEAD	
Goals: • Demonstrate the ability to penetrate and rupture double-hull submarines. • Demonstrate high lethality from all aspect angles. • Weapon system compatible with the MK50 torpedo.	Why Project Merits BTI Funding: • Provides a unique conventional warhead concept capable of rupturing double-hull submarines from all angles. • Current warheads are aspect dependent. • Provides a future warhead alternative for the current MK50 Torpedo.
ADVANCED MINE SYSTEM	
Goals: • Develop a smart mine system to deny enemy helicopters nap-of-earth flight. • Demonstrate the ability to remotely control smart mines that sense helicopters and armored vehicles.	Why Project Merits BTI Funding: • Provides the ability to neutralize threat helicopters either directly or indirectly. • Provides the ability to turn off a mine field to permit friendly operations. Capability will be available for use in Army's Wide Area Mine (WAM) program. • Control of minefield enables new operational concepts for use of mines.

Table 1b. Target Acquisition Projects

MULTISENSOR-AIDED TARGETING	
Goals: • Develop multisensor target cueing and acquisition for ground vehicles and combat aircraft against ground targets. • Develop displays and controls permitting early engagement and high-rate engagement of enemy forces.	Why Project Merits BTI Funding: • Ground force that finds the enemy first has a big advantage. • Ability to find and engage many targets quickly improves kill ratio and defeats enemy force. • Puts speed of target acquisition and engagement decisions on a par with automatic loaders.
SMART WEAPONS OPERABILITY ENHANCEMENT (Part of Multisensor-Aided Targeting)	
Goals: • Develop real-time modeling of three-dimensional terrain scenes by FY1991. • Incorporate climatic and operational effects by FY1992. • Incorporate target signatures in the simulated scenes by FY1992.	Why Project Merits BTI Funding: • Addresses the need to simulate battle zone environments in the development and testing of automatic target recognition (ATR) systems. • Will significantly improve ATR development by providing great variety and repeatability needed for development of robust algorithms.
WEAPON IMAGE PROCESSOR (ALADDIN) (Part of Multisensor-Aided Targeting)	
Goals: • Develop a modular generic Smart Weapons computer, small enough (4-in. diameter) to fit into a small submunition. • Develop 10 "turnkey" sets with software and a generic ATR algorithm programmed with conventional languages on a standard workstation.	Why Project Merits BTI Funding: • The availability of a computer small enough to fit into a submunition represents a major contribution to submunition development in all three services. • The processing power it will provide enables even small weapons to autonomously find targets. • The miniaturized processor will have applications to manned weapon systems.

(continued)

Table 1b. Target Acquisition Projects (continued)

BATTALION TARGETING SYSTEM	
Goals: • Develop a system providing real-time or near-real-time intelligence on nearby enemy forces. • Show applicability of the system to small-unit commanders.	Why Project Merits BTI Funding: • Major problem for commanders of battalions, brigades, and small tank forces (e.g., SO/LIC) is knowing where the enemy is and what the enemy is doing. • Great need for these small-unit commanders to obtain timely information on forces within 20 km.
TARGET ACQUISITION FOR SHIP DEFENSE	
Goals: • Demonstrate accurate, reliable detection, acquisition and tracking of low-altitude, low-RCS and high-speed attacking missiles. • Demonstrate rapid detection and precision tracking in marine multipath and sea-clutter environment. • Demonstrate the integration of dual-band Ku/W radar system.	Why Project Merits BTI Funding: • Provides the capability to defeat a key threat to naval units, the antiship missile. • Provides multiservice application of millimeter-wave (MMW) radar in a marine environment, and provides sensor for future CIWS. • Program will complete a live demonstration early in FY1991.

Table 1c. Battle Management/C^{3}I Projects

COMBAT VEHICLE COMMAND AND CONTROL (CVC2)	
Goals: • Develop embedded command and control capability for tanks and infantry fighting vehicles. • Test software for performing all command and control functions and evaluate value added. • Demonstrate interoperability of U.S. and allied forces combat vehicles by FY1992.	Why Project Merits BTI Funding: • Develop leap-ahead technology enabling closely coordinated, rapid operations of tank units. • Applicable to the future Block III Tank Full Scale Development Program in FY1992. • Demonstrates joint operations between U.S. and FRG vehicles at the battalion level.
ARTIFICIAL INTELLIGENCE MODULE	
Goals: • Develop software to automate situation assessment and predict 72 hours into the future. • Identify high-value targets, such as command and control centers and high-value artillery targets. • Conduct a field evaluation at the corps and division levels.	Why Project Merits BTI Funding: • Provides the corps and division commanders a more thorough "picture" of the battlefield situation. • This project represents a major improvement and will be incorporated into the ASAS P^{3}I program.

(continued)

Table 1c. Battle Management/C^3I Projects (continued)

TACTICAL USE OF NATIONAL TECHNICAL MEANS (TACNAT)	
Goals: • Automate the monitoring of threat garrisons, such as tactical ballistic missile sites, and predict changes. • Predict and determine likelihood of target field locations and deployment sites.	Why Project Merits BTI Funding: • Will radically reduce Army and Air Force targeting cycle times for U.S. and NATO weapon systems. • Will improve the ability to detect and adapt to changes in Soviet behavior. • Has been positively evaluated in live exercises.
IMAGE EXPLOITATION SYSTEM (IES)	
Goals: • Develop a laboratory capability for detecting, classifying, and positioning key tactical targets from imagery intelligence resources in FY1990. • If continued beyond Concept Evaluation, develop a testbed for automated synthetic aperture radar (SAR) exploitation and delivery to the user CONUS facility by FY1992. • Develop an automated processing facility for SAR and IR multispectral imagery exploitation and deliver to European sites for operational test and use by FY1993.	Why Project Merits BTI Funding: • Provides ability to target for Deep Operations and FOFA with limited manpower. • Provides a test facility for making go/no-go decision to proceed further on the IES concept. • Delivers an operational system for the corps commander to perform automated Deep Operations and FOFA targeting.

Table 1d. Smart Weapons Projects

IR COUNTERMEASURE SYSTEM	
Goals: • Upgrade current subsystems and demonstrate near-term protection of transport and bomber aircraft from IR-guided missiles in FY1992. • Develop an airborne IR countermeasure system to protect combat aircraft from advanced IR threat missiles in FY1993.	Why Project Merits BTI Funding: • Defeats the IR missile threat, one of the most significant threats to our combat and transport aircraft. • Demonstrates multiservice capability in detecting, tracking and defeating IR missiles.
FIBER-OPTIC NAVAL WEAPONS	
Goals: • Develop and demonstrate dual-spool fiber-optic payout system. • Demonstrate payout for unpowered and powered weapons.	Why Project Merits BTI Funding: • Fiber-optic links can lower cost of weapons. • Significant multiservice utility for guided systems in jamming environment.
MILLIMETER-WAVE (MMW) BATTLEFIELD AIR INTERDICTION (BAI) WEAPON	
Goals: • Integrate and flight-test MMW seekers on the AGM-65 Maverick missile. • Demonstrate MMW seeker ability to locate targets in clutter and discriminate air defense units from other targets. • Demonstrate the capability to autonomously prioritize targets and track to kill.	Why Project Merits BTI Funding: • Provides a day/night, adverse weather, autonomous, lock-on-after-launch weapon for standoff delivery against fixed and mobile air defense units, moving and massed armor, and other mobile battlefield targets. • Enables tactics that reduce aircraft attrition while conducting battlefield air interdiction.

(continued)

Table 1d. Smart Weapons Projects (continued)

PRECISION DELIVERY SYSTEM	
Goals: • Develop a weapon that can be used in any part of the world even without foreign bases. • Show capability to destroy specific parts of large, fixed targets with great precision from standoff range.	Why Project Merits BTI Funding: • Capability needed for early phases of warfare before we have large operating area for tactical forces. • Capability needed for key command, air defense, infrastructure and logistics targets. • Capability provides means of sending a political message without putting a ground force in country.
AUTONOMOUS GUIDANCE FOR CONVENTIONAL WEAPON (AGCW) (Part of Precision Delivery System)	
Goals: • Integrate and flight-test an autonomous imaging infrared sensor on a standoff weapon. • Demonstrate autonomous imaging infrared target acquisition, aimpoint selection, tracking and terminal accuracy. • Demonstrate user mission planning concepts using existing mission planning capabilities to program high-value targets.	Why Project Merits BTI Funding: • Provides a capability for day/night, autonomous standoff weapons for destroying specifically selected high-value fixed targets. • Provides the terminal guidance for the Precision Delivery System.

(continued)

Table 1d. Smart Weapons Projects (continued)

ADVANCED CLOSE AIR SUPPORT SYSTEM	
Goals: • Integrate, and flight-demonstrate on an F-16, technologies that lead to more weapons on target. • Demonstrate two-ship digitally intemetted ground attack operations. • Demonstrate first-pass target acquisition and kill through improved cueing to target, sensor-aided target acquisition, and precise weapon delivery. • Demonstrate improved target area ingress/egress capability using aids to increase pilot situation awareness and mission management capability. • Demonstrate night attack capability.	Why Project Merits BTI Funding: • Provides greatly improved capability for aircraft to navigate, accurately attack, and survive day or night. • Technologies demonstrated cut across service boundaries and are applicable to any fixed-wing attack aircraft having digital capabilities. • Improves our capability to perform both close air support and battlefield air interdiction.
LOW-COST ANTIARMOR SUBMUNITION	
Goals: • Develop a submunition that can be produced for less than $15,000 and that will have high effectiveness against enemy armored vehicles including future battle tanks.	Why Project Merits BTI Funding: • An affordable, effective submunition can transform conventional warfare. The side with a good supply of the best submunitions will have a big advantage. • Current submunitions have limited search area and limited lethality against armor. • Developmental submunitions are either expensive or have limited search area and lethality.

Table 1e. Special Operations/Low-Intensity Combat (SO/LIC) Projects

UNCOOLED FOCAL PLANE ARRAY DEMONSTRATION	
Goals: • Develop and demonstrate a low cost, uncooled IR imager suitable for use in seekers, individual weapon sights and security sensors.	Why Project Merits BTI Funding: • Provides sensors for unattended security surveillance and infantry weapon sights. • Potentially can become low cost sensor for short to medium range missiles. • Potentially provides a significant improvement for missile systems such as FOG-M.
AVIONICS FOR SPECIAL OPERATIONS (QUIET KNIGHT)	
Goals: • Integrate and flight-demonstrate suite of avionics in a special operations C-130 aircraft that provides low detectability to passive sensors (reduced emissions) and reduced detectability to active sensors (improved terrain masking). • Demonstrate nap-of-earth flight day or night with greatly reduced or no RF emission, real-time threat avoidance and reduced crew workload.	Why Project Merits BTI Funding: • Provides special operations aircraft with significant new capability to penetrate sensitive areas without being detected.

Table 2a. BTI Projects That Have Been Completed

Project Title	Status	Funding (Actual) Prior Years ($M)
Projects Completed in FY1987		
IR Focal Plane Array Producibility	Complete	1.950
Amphibious Assault Countermine System	Complete	2.000
Penetrator/Target Interaction Flash X-Ray Facility	Complete	4.000
Projects Completed in FY1988		
Digital Topographic Support System (DTSS)	Complete	6.000
Projects Completed in FY1989		
Armor Materials	Complete	5.969
High Energy Laser for Ship Defense	Complete	5.000
Superconducting Ceramic Materials	Complete	3.000
Cruise Missile Advanced Guidance	Complete	7.375
ACE Distributed Wargaming	Complete	18.000

Table 2b. BTI Projects That Will Not Continue Under the Restructured Program

Project Title	Funding (Actual or Planned)		
	FY 1989(A) ($M)	FY 1990(P) ($M)	FY 1991(P) ($M)
Army Projects			
Coilgun Technology Development	6.185	12.90	16.30
Liquid Propellant Gun	0.619	6.70	9.00
Enhanced Computational Capability for Advanced Weapon System Development	0.500	6.10	5.30
Tactical Missile Interceptor Development	3.396	6.40	4.20
Joint IR/Laser Seeker	5.000	10.00	10.00
Materials for Advanced Weapons Systems	4.106	11.50	15.00
Ground-Launched HELLFIRE	5.000	2.60	
Command Adjusted Trajectory	6.400	11.00	11.00
DARPA Projects			
Multimission Seeker Development	2.393	12.50	12.50
Guided Projectile Portion of Guided Tactical Hypervelocity Projectiles	3.700	4.87	3.60
High Lethality Area Warhead	0.500		
High Power/Energy Density Batteries	1.750	3.50	6.50
Optical Signal Processing Technology	1.588	15.00	21.50
Active Optical Countermeasures	6.200	10.90	15.00
Monolithic IR Focal Plane Arrays	0.896	5.00	7.50
Materials for Advanced Weapons Systems	0.000		
Advanced Composite Gun	4.000	5.00	4.00
Enhanced Computational Capability for Advanced Weapon System Development	2.653		
Expert Systems for Manufacture of Smart Weapons	2.072	7.00	8.00

(continued)

Table 2b. BTI Projects That Will Not Continue Under the Restructured Program (continued)

Project Title	Funding (Actual or Planned)		
	FY 1989(A) ($M)	FY 1990(P) ($M)	FY 1991(P) ($M)
Air Force Projects			
Multisensor Autoprocessor Technology	1.600	5.40	5.00
Navy Projects			
Advanced Airborne (A/B) Antiair Warfare (AAW) Engagement System	4.600	7.20	8.00
Advanced Warheads for Conventional Cruise Missiles	3.578	5.00	5.00
High Performance IR Seeker	8.700	19.50	15.50
Undersea Surveillance	18.402	26.00	29.10
Submarine Antitorpedo Weapon	7.912	17.00	12.00
SIDEARM II Technology	0.000	9.00	11.50
AV8B Vulnerability Reduction	0.000		
High-Power Microwave (HPM) Tri-Service Projects			
HPM Tri-Service	11.727	10.00	10.00
HPM Technology Demonstration	11.500	15.00	12.00
OSD Projects			
Enhanced Blast Munitions	1.617	7.30	7.00
TOTALS	126.594	252.37	264.50

Table 2c. BTI Projects That Have Been Reorganized Under the Restructured Program

Project Title	Status	Funding (Actual or Planned) FY 1989(A) ($M)	FY 1990(P) ($M)	FY 1991(P) ($M)
<u>Army Projects</u>				
Aided Target Recognition	Combined	5.205	9.50	5.50
Smart Weapons Operability Enhancement	Combined	4.800	8.20	8.20
<u>DARPA Projects</u>				
Advanced Mine/Countermine Technology	Curtailed	7.962	15.00	12.00
Automatic Target Recognition for Smart Weap. (ALADDIN)	Combined	5.675	10.00	8.00
Deep Battle Weapon Concept	Combined	7.923	10.00	
Fire Control Portion of Guided Tactical Hypervelocity Projectiles	Combined	5.495	4.42	8.02
TOTALS		37.060	57.12	41.72

Table 3. FY1990 Funding Plan
Balanced Technology Initiative Projects,
Restructured Program

Projects Sorted by Thrust Area	FY 1990 ($M)
Advanced Armament Projects	
Electrothermal Gun Technology (Army/Navy)	18.5
Enhanced Kinetic Energy Munition (X-Rod)	10.0
Short-Range Antitank Weapon (Marine Corps)	11.0
Followthrough Torpedo Warhead	5.0
Advanced Mine System	9.5
Target Acquisition Projects	
Multisensor-Aided Targeting	23.2
Target Acquisition for Ship Defense	3.4
FY90 Start--Battalion Targeting System	4.0
Battle Management/C^3I Projects	
Combat Vehicle Command and Control	9.0
Image Exploitation System	2.0
Artificial Intelligence Module	9.7
Tactical Use of National Technical Means (TACNAT)	8.0
Smart Weapons Projects	
IR Countermeasure System	19.5
Fiber-Optic Naval Weapons	8.5
Millimeter-Wave BAI Weapon	15.0
Precision Delivery System	16.8
Low-Cost Antiarmor Submunition	12.5
Advanced Close Air Support System	4.3

(continued)

Table 3. FY1990 Funding Plan
Balanced Technology Initiative Projects,
Restructured Program (continued)

Projects Sorted by Thrust Area	FY 1990 ($M)
Special Operations (SO/LIC) Projects	
Uncooled Focal Plane Array Demonstration	8.0
Avionics for Special Operations (Quiet Knight)	13.2
High Power Microwave Projects	
Ultrawide-Band Radar and Light-Activated HPM	25.0
Program Planning and Technical Assessment	
Program Planning and Technical Assessment	2.884
Classified Project(s)	
Classified Project(s)	6.0
Future New Starts[a]	
FY91 Start--Project 1	
FY92 Start--Project 2	
FY92 Start--Project 3	
FY92 Start--Project 4	
FY93 Start--Project 5	
FY93 Start--Project 6	
FY94 Start--Project 7	
GRAND TOTALS	244.984

Note: The 1990 funds include $38.9M of prior year funds.

[a] Future new starts are not specifically identified because they must first withstand a rigorous review and validation.

ANNEX 1

A REPRESENTATIVE SET OF CRITERIA FOR SELECTING BTI PROJECTS

Select probjects that:

(a) Combine to constitute a significant thrust of initiative under BTI leadership.

(b) Are technology application oriented--not technology base development.

(c) Have or can develop strong user community interest and support.

(d) Can lead to the development and fielding of capabilities intended to provide a decisive margin to winning a conflict, to avoid losing a conflict, or to significantly leverage other investments.

(e) Are not a critical element of a service or other agency major program or initiative.

(f) Exploit technology breakthroughs or satisfy newly recognized operational needs and are able to be initiated faster than the normal service requirements/POM decision process.

(g) Have potential for a "proof of concept" within 2-3 years and significant operational payoff in 5-7 years.

(h) Can reach some reasonable milestone within BTI funding constraints.

(i) Have potential for multimission area or multiservice application, e.g., counter-armor/low-flying aircraft/helicopter weapon.

ANNEX 2. PROJECT APPLICABILITY TO SO/LIC[a]

	Advanced Armaments	Target Acquisition	Battle Management	Smart Weapons	Special Operations	High Power Microwave	Program Planning	Funds FY90-FY94
No Likely Applications to SO/LIC[b]	Followthrough Torpedo Warhead FY92 Start	Multisensor-Aided Targeting Target Acquis. for Ship Defense FY92 Start FY93 Start	Combat Vehicle Command/Control Artificial Intell. Module	FY91 Start FY92 Start FY93 Start				39%
Potential Application to SO/LIC	Electrothermal Gun Technology Enhanced Kinetic Energy Munition Short-Range Anti-tank Weapon	Battalion Targeting System	Imagery Exploitation	Fiber Optics Naval Weapons Millimeter-Wave BAI Weapon Advanced Close Air Support				20%
Direct Application to SO/LIC	Antihelicopter Mine		Tactical Use of National Technical Means	IR Countermeasures Surgical Strike Weapon Low-Cost Anti-armor Weapon	Uncooled Focal Plane Array FY94 Start	Ultrawide-Band Radar/HPM		24%
Specifically for Special Operations					Special Ops Avionics			16%
							Planning/ Tech Assessment	1%

[a] Including future starts that currently are only tentatively identified.
[b] Applicable to major involvement in third world regional wars.